Maple 6 Spreadsheets

In Maple 6 the user may insert a spreadsheet into the Maple worksheet. One characteristic of these spreadsheets that must be noted early is that changing an entry does not cause the spreadsheet to immediately recalculate as is the case in the standard spreadsheet. This is easily done by clicking on a button, however. The reader is reminded that the easiest way to get help or information about spreadsheets in Maple is to enter a worksheet and type in

> `?spreadsheet` <enter>

and a list of topics is displayed. The reader is warned that there is an error in the identification of row and column headers in the section that tries to explain which is which. Column headers are listed in a row as A, B, C, etc. while row headers are listed next to the first column as 1, 2, 3, etc. This is reversed in the diagram you would see in the help display.

Please open a blank worksheet and enter the following lines:

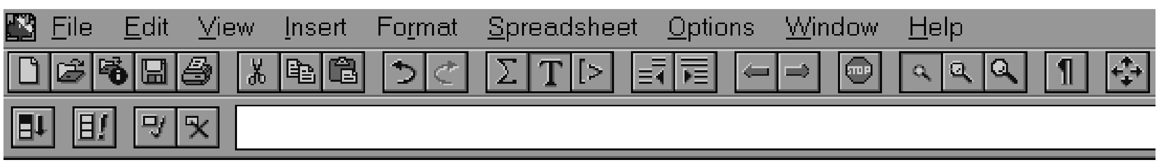
```
> with(student):
> f:=x->2+2*x-x^2;
```

$$f := x \to 2 + 2x - x^2$$

```
> g:=x->sin(2*x);
```

$$g := x \to \sin(2x)$$

With the mouse, move the cursor arrow to the command **Insert**, click and then click on **Spreadsheet**. In addition to the material already entered, you should see a blank spreadsheet ready to be resized to fit your needs. Before we do that, note that the menu bars above have changed and that they look like this:



Before you inserted the spreadsheet, you could not select **Spreadsheet**, but now it is an option. Click on it and check out the menu. Note the four boxes on the left and below the main bar. The one to the left is very useful. When you need to fill cells in a spreadsheet in some direction, click on this box. More specific instructions follow when this process is needed in our example.

Now we are ready to resize the blank spreadsheet. Outside the spreadsheet, but near the lower righthand corner, click the mouse. A drag box outline should appear around the spreadsheet. Then, move the cursor to that corner until the diagonal arrow appears. Move that corner down and to the left so that you end up with five columns and 15 or so rows. This might take several tries. When you have done this, click on the cell in row 1 and column A. In the first row, enter *x*, *f(x)*, *x*, and *g(x)*. The arrow keys will move from one cell to another. You will note that the value of the function has appeared where you entered $f(x)$ and $g(x)$. We are going to illustrate different methods to accomplish the same things. In cell **A2** enter 0 and move to cell **B2**. One option here is to enter `f(~A2)` and we will do that. The other is to enter `eval(~$B$1,x=~A2)`. The dollar signs mean that cell **B1** will always be used and not just refer to the cell directly above. This is an *absolute* reference rather than a *relative* one.

Our objective now is to fill in the two columns, **A** and **B**. Click on **A2** and highlight down to cell **A12**. The menus at the top of the screen change when you are in a spreadsheet. At the extreme left and on the third row of the menus, you will find a button that looks like three window panes and the shade is pulled down in the top one. It also has an arrow pointing down. Click on this button and a menu pops up. Click on the window that indicates 'step size' and enter .1 , then click on **OK**. You should see the first column of the completed spreadsheet. Move to cell **B2** and highlight down to **B12**. On the top line of the menus click **Spreadsheet**, click on **Fill - Down**. You don't actually click on **Fill** because when the arrow touches it, the side menu with **Down** pops up immediately. This should complete the second column.

Before continuing with the spreadsheet entries, move the cursor outside of the spreadsheet to the command line above the spreadsheet and hit <Enter>. This should cause a command line to appear below the spreadsheet. Enter $M :=$ on that line and then highlight the cells in the first two columns from **A2** to **B12**.

Click on the **Copy** button, move the cursor to after the $M :=$ on the line below, and click on the **Paste** button. Immediately put a colon at the end of the line and then <Enter>. The colon suppresses the output, which is a matrix of 2×2 matrices. On the next line enter `c:=convert(M,‘list‘)[1];` , being careful to use a left single quote on both sides of *list*, and a list of those 2×2 matrices is shown. We can use this list in an interesting way. Enter `plot(c,style=line);` and <Enter>, and a plot appears. It is rather smooth because our x values are close together.

Let's return to the spreadsheet and put 0 in cell **C2**. Move down to cell **C3** and enter `~C2+Pi/12` . Then, highlight from **C3** to **C12** and click on **Spreadsheet, Fill - Down**. In cell **D2** enter `eval(~$D$1,x=~C2)` and 0 appears. Highlight **D3** down to **D12**, then click on **Spreadsheet, Fill - Down**. This completes the spreadsheet.

Here is the tricky part. To plot the second function, highlight the rectangular area **C2** to **D12**, copy and paste to the command line below the spreadsheet, insert
`M1:=` before `MATRIX`,
a colon `:` at the end of the last line, and <Enter>.
On the next line put
`c1:=convert(M1,‘list‘)[1];` <Enter>
and follow that line with
`plot(c1,style=line);` and <Enter>,
and a polygonal graph appears. The spreadsheet is on the right and the remainder of the worksheet follows.

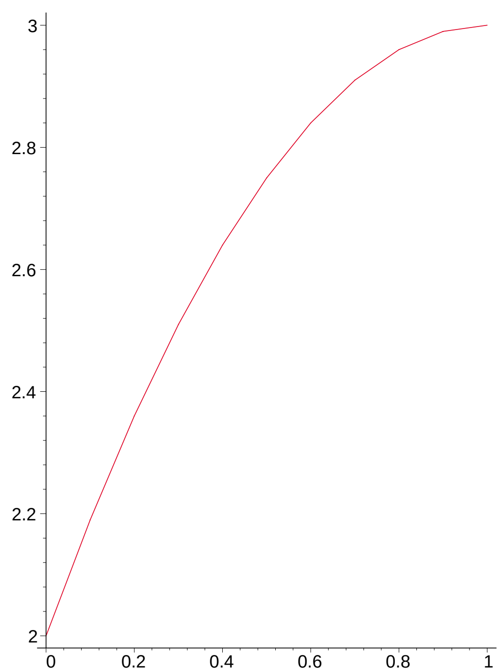
	A	B	C	D
1	x	$2+2x-x^2$	x	$\sin(2x)$
2	0	2	0	0
3	.1000	2.1900	$\frac{1}{12}\pi$	$\frac{1}{2}$
4	.2000	2.3600	$\frac{1}{6}\pi$	$\frac{1}{2}\sqrt{3}$
5	.3000	2.5100	$\frac{1}{4}\pi$	1
6	.4000	2.6400	$\frac{1}{3}\pi$	$\frac{1}{2}\sqrt{3}$
7	.5000	2.7500	$\frac{5}{12}\pi$	$\frac{1}{2}$
8	.6000	2.8400	$\frac{1}{2}\pi$	0
9	.7000	2.9100	$\frac{7}{12}\pi$	$\frac{-1}{2}$
10	.8000	2.9600	$\frac{2}{3}\pi$	$-\frac{1}{2}\sqrt{3}$
11	.9000	2.9900	$\frac{3}{4}\pi$	-1
12	1	3	$\frac{5}{6}\pi$	$-\frac{1}{2}\sqrt{3}$

```
> M:=MATRIX([[0, 2], [.1, 2.19], [.2, 2.36], [.3, 2.51], [.4, 2.64], [.5, 2.75],
  [.6, 2.84], [.7, 2.91],[.8, 2.96], [.9, 2.99], [1, 3]]):

> c:=convert(M,‘list‘)[1];
```

c := [[0, 2], [.1, 2.19], [.2, 2.36], [.3, 2.51], [.4, 2.64], [.5, 2.75], [.6, 2.84], [.7, 2.91], [.8, 2.96], [.9, 2.99], [1, 3]]

```
> plot(c,style=line);
```

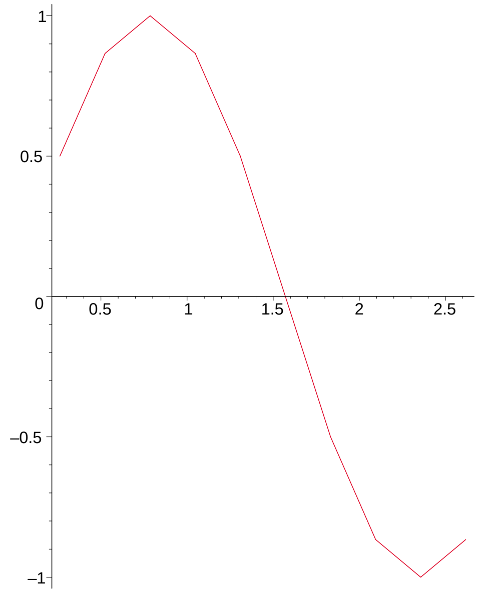


```
> M1:=MATRIX([[1/12*Pi, 1/2], [1/6*Pi, 1/2*sqrt(3)], [1/4*Pi, 1], [1/3*Pi, 1/2*sqrt(3)],
  [5/12*Pi, 1/2],[1/2*Pi, 0], [7/12*Pi, -1/2], [2/3*Pi, -1/2*sqrt(3)], [3/4*Pi, -1],
  [5/6*Pi, -1/2*sqrt(3)]]):
```

```
> c1:=convert(M1,'list')[1];
```

$$c1 := [[\frac{1}{12}\pi, \frac{1}{2}], [\frac{1}{6}\pi, \frac{1}{2}\sqrt{3}], [\frac{1}{4}\pi, 1], [\frac{1}{3}\pi, \frac{1}{2}\sqrt{3}], [\frac{5}{12}\pi, \frac{1}{2}], [\frac{1}{2}\pi, 0], [\frac{7}{12}\pi, \frac{-1}{2}],$$
$$[\frac{2}{3}\pi, \frac{-1}{2}\sqrt{3}], [\frac{3}{4}\pi, -1], [\frac{5}{6}\pi, \frac{-1}{2}\sqrt{3}]]$$

```
> plot(c1,style=line);
```



Do you remember the array of trigonometric derivatives in the Review section at the beginning of these notes? It should be easy to duplicate using a Maple spreadsheet. Open a spreadsheet and in the first row insert *function*, *derivative*, *cofunction*, *derivative*. In the first column, **A**, starting with **A2**, enter *sin(x)*, *tan(x)*, and *sec(x)*. Move to **B2** and enter `diff(~A2,x)`. Highlight **B2** to **B4**, then click on **Spreadsheet, Fill - Down** successively. Enter the cofunctions in Column **C**, and the derivatives in column **D** similar to how you handled column **B**.

	A	B	C	D
1	*function*	*derivative*	*cofunction*	*derivative*
2	$\sin(x)$	$\cos(x)$	$\cos(x)$	$-\sin(x)$
3	$\tan(x)$	$1+\tan(x)^2$	$\cot(x)$	$-1-\cot(x)^2$
4	$\sec(x)$	$\sec(x)\tan(x)$	$\csc(x)$	$-\csc(x)\cot(x)$

Let's consider one more example. Start a worksheet, define a function $f(x) = \cos(2x)$, and set $a = Pi/6$ Open a spreadsheet and in cell **A1** put $f(x)$. Move to **A2** and enter `diff(~A1,x)`. Highlight **A2** down to **A8**. Click on **Spreadsheet, Fill - Down** and note that succesive derivatives appear. In **B1**, put `eval(~A1,x=a)` and then highlight **B1** down to **B8**. Click on **Spreadsheet, Fill - Down**. When you reach the section on Taylor series you will realize just how useful a spreadsheet like this example can be.